

Executive Summary

Recent increases in the number of Caspian terns nesting in the Columbia River estuary has led to concerns over their potential impact on the recovery of threatened and endangered Columbia River salmonids. In 1999, National Marine Fisheries Service (NOAA Fisheries) called for the U.S. Army Corps of Engineers (Corps) to eliminate tern nesting from Rice Island (located in the upper estuary) in an attempt to decrease the number of juvenile salmonids eaten by terns. In 1999, the Corps initiated a pilot project to attract the Rice Island tern colony to East Sand Island, near the mouth of the estuary, where marine fish (i.e., non-salmon) were abundantly available to foraging terns. In 2000, the Corps proposed to complete the project to prevent all tern nesting on Rice Island while attracting terns to nest on East Sand Island. As a result of the proposed actions in 2000, Seattle Audubon, National Audubon, American Bird Conservancy, and Defenders of Wildlife filed a lawsuit against the Corps alleging that compliance with the National Environmental Policy Act for the proposed action of attracting the large colony of Caspian terns from Rice Island to East Sand Island was insufficient, and against the Service in objection to the potential take of eggs as a means to prevent nesting on Rice Island. In 2002, all parties reached a settlement agreement. The settlement agreement stipulates that the Service, Corps, and NOAA Fisheries prepare an EIS to address Caspian tern management in the Columbia River estuary and juvenile salmonid predation.

The purpose of the proposed action is to comply with the 2002 Settlement Agreement by identifying a management plan for Caspian terns in the Columbia River estuary that reduces resource management conflicts with ESA-listed salmonids while ensuring the conservation of Caspian terns in the Pacific Coast/Western region. Although the relocation of terns from Rice Island to East Sand Island resulted in a decreased percentage of salmonids in the tern diet, the Caspian tern colony on East Sand Island is anticipated to continue to increase in size. Thus, predation of juvenile salmonids by terns may increase in the future, maintaining a concern for salmon recovery by NOAA Fisheries.

Alternatives

The four alternatives considered in the Draft EIS are summarized below, followed by features common to all alternatives.

Alternative A – No Action (Current Management Program)

The “No Action” alternative assumes no change from the current management program on East Sand Island and is the baseline from which to compare the other alternatives. Under this alternative, 6 acres of nesting habitat would be prepared annually for Caspian terns on East Sand Island. This requires annual maintenance to provide proper nesting habitat conditions: a bare sand substrate free of vegetative cover. To attain the proper habitat, heavy equipment is used to till and smooth the site in late May or early April (prior to the arrival of terns). Herbicide (Rodeo) may also be applied to the vegetation in the fall (September or October) to control their presence on the tern nesting site.

Alternative B – No Management

The Settlement Agreement requires analysis of this alternative in the EIS. Under this alternative, no management actions would occur on East Sand Island. The current tern nesting habitat on East Sand Island would most likely become fully vegetated within three years. This would result in the loss of the tern nesting site. Thus, abandonment of this colony on East Sand Island would most likely occur.

Alternative C – Redistribution of East Sand Island Tern Colony - PREFERRED ALTERNATIVE

Alternative C, the Preferred Alternative, would reduce tern predation on juvenile salmonids in the Columbia River estuary by managing habitat to redistribute the tern colony on East Sand Island throughout the Pacific Coast/Western region. This redistribution would be achieved by creating new or enhanced tern nesting habitat throughout the region and reducing the tern nesting site on East Sand Island to 1 to 1.5 acres. To ensure a suitable network of sites is available for terns on a regional scale, we propose to manage nesting habitat for terns in the region to replace twice the amount of nesting habitat that would be lost on East Sand Island. Since terns nested on an average of 4.3 acres on East Sand Island from 2001 to 2003, approximately 6 to 7 acres would need to be replaced when the site on East Sand Island is reduced to 1 to 1.5 acres.

The proposed reduction in habitat on East Sand Island would occur only after nesting habitat is enhanced elsewhere in the region. Thus, habitat enhancement in the region and reduction in habitat on East Sand Island would be phased in at a 2:1 ratio. Approximately 8 acres of managed habitat

would be enhanced in Washington, Oregon, and California. Seven proposed management sites considered in this alternative include Dungeness National Wildlife Refuge, Washington; Summer, Crump, and Fern Ridge lakes, Oregon; and San Francisco Bay (3 sites), California. See Table 2.1, Chapter 2 and Appendix G for more detail on these sites and proposed management actions.

The proposed habitat acreage (approximately 1 to 1.5 acres) on East Sand Island is expected to be reached in 3 to 5 years, depending upon available funding for habitat enhancement elsewhere in the region. The size of the tern nesting site at East Sand Island (acreage) would be determined annually, and would be dependent upon how much acreage of alternate habitat has been created to date elsewhere in the region. Habitat reduction on East Sand Island would be attained by allowing vegetation to grow in the current nesting area and the remaining tern nesting site would be cleared via the methods described above in Alternative A.

This proposed habitat acreage on East Sand Island (1 to 1.5 acres) was selected for this alternative to reduce tern predation in the estuary on juvenile salmonids to a level that would increase salmonid population growth rates (λ). In determining an acceptable predation level by terns, NOAA Fisheries conducted an analysis using a life cycle model and tern predation rates to estimate the impact of tern predation on the population growth rate of various Evolutionary Significant Units (ESUs) of Columbia River Basin steelhead. Steelhead were the focus of this analysis because they are the ESUs most affected by tern predation in the Columbia River estuary. Thus, estimates of the potential benefits to reducing tern predation are the greatest for steelhead but other Columbia River salmonid ESUs subject to tern predation would also benefit.

The NOAA Fisheries analysis estimated that a reduction in the tern colony to approximately 3,125 nesting pairs would result in the one percent or greater increase in population growth rate for all Columbia River Basin steelhead ESUs. Because of uncertainties in the model, we propose to manage for a more conservative range of nesting pairs (approximately 2,500 to 3,125) on East Sand Island to ensure an increase in population growth rate for all Columbia River Basin steelhead ESUs. Based on average nesting densities observed on East Sand (0.55 nesting pairs per square meter) and Rice islands (0.78 nesting pairs per square meter), this proposed range of nesting terns would be able to nest on the proposed habitat acreage (approximately one to 1.5 acres). Based upon the average number of nesting pairs (approximately 9,070) in the Columbia River estuary for 2000 through 2003, approximately 5,945 to 6,570 breeding pairs of Caspian terns would be displaced from nesting on East Sand Island with implementation of this alternative.

Alternative D – Redistribution and Lethal Control of East Sand Island Tern Colony

Similar to Alternative C, tern nesting habitat and colony size on East Sand Island proposed in this alternative would be reduced to decrease tern predation on juvenile salmonids and encourage redistribution of the large concentrated tern colony to other nesting sites within the Pacific Coast region. Similar to Alternative C, approximately 8 acres from sites within the Pacific Coast region would be managed as potential Caspian tern nesting sites to replace the habitat lost on East Sand Island to ensure a network of suitable nesting habitat is available to displaced terns. As with Alternative C, the proposed habitat acreage (approximately 1 to 1.5 acres) and anticipated number of nesting terns was selected to increase the population growth rate for Columbia River Basin steelhead by at least 1 percent. Also sites would be selected from the same seven sites identified in Alternative C. Reduction in tern nesting habitat on East Sand Island would be phased in as habitat at alternate sites is developed at a 2:1 ratio (see description in Alternative C). Also similar to Alternative C, we expect the tern nesting area would be reduced to 1 to 1.5 acres within 3 to 5 years, depending upon available funding for habitat enhancement elsewhere in the region.

Unlike Alternative C, if development of potential nesting habitat elsewhere in the region and subsequent habitat reduction on East Sand Island is not sufficient to reduce the colony size by 2008, a lethal control program would be used in conjunction with these measures to achieve the proposed range of nesting terns (approximately 2,500 to 3,125 pairs in the estuary). The lethal control program would kill up to 50 percent of breeding adult terns each year beginning in 2008. Methods for killing adults could consist of euthanasia of terns after capturing them with a rocket net and use of shotguns to remove individual terns. The actual number of terns that would be killed under this alternative would depend on the success of redistributing a majority of the colony to other sites in the region. If the entire colony nested in the smaller acreage that would remain on East Sand Island, a substantial number of terns would need to be killed. If the colony was partially reduced through habitat reduction, a lower number of terns would be killed (see Chapter 4, section 4.2.1.4 for projections of number of terns that would need to be killed under a lethal control program).

Features Common to All Alternatives

The following components are proposed to be implemented under all alternatives (A through D):

1. The Corps would continue non-lethal efforts, such as hazing, to prevent Caspian tern nesting on upper estuary islands (e.g., Rice Island, Miller Sands Spit, Pillar Rock Island) of the Columbia

River estuary to prevent high tern predation rates of juvenile salmonids in compliance with the 1999 Corps Columbia River Channel Operation and Maintenance Program Biological Opinion;

2. The Service would issue an egg take permit to the Corps for upper estuary islands (not including East Sand Island) if the non-lethal efforts to prevent tern nesting at these sites fail; and

3. The Corps would resume dredged material(e.g., sand) disposal on the downstream end of Rice Island, on the former Caspian tern nesting site.

Affected Environment

The EIS study area encompassed ESA-listed salmonid habitat in the Columbia River Basin and Caspian tern nesting habitat in the States of Washington, Oregon, California, Idaho, and Nevada. This study area falls within the breeding range of the Pacific Coast regional population of Caspian terns and the management jurisdiction of the three cooperating agencies (U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, NOAA Fisheries).

During the planning process, the affected environment for this DEIS was more specifically identified as those Caspian tern nesting areas within Washington, Oregon, and California that are most likely to be affected by proposed management alternatives under consideration in this DEIS. The affected environment extends from the Columbia River estuary, the area of primary management concern, into those sites proposed for Caspian tern management for displaced terns from East Sand Island. Although we anticipate that the boundaries of the affected environment extends to all areas potentially affected by proposed management alternatives, Caspian terns may pioneer into locations not discussed in this DEIS on their own volition. Thus, since this species takes advantage of ephemeral habitat and forage conditions over a wide geographical range, we cannot predict with complete certainty where colonies would establish themselves in the future.

The following summary of the affected environment focuses on Caspian terns and ESA-listed salmonids. See Chapter 3 for the full description of the affected environment.

Caspian Terns

Caspian terns breeding in the Columbia River estuary are in the Pacific Coast/Western breeding region of the North American population. In recent years, terns were documented to have nested on about 60 sites scattered throughout the Pacific Coast region, including Alaska. The tern breeding

population in the Pacific Coast region is the largest within the United States. This regional population has increased exponentially since the early 1960s. The overall regional population increase, beginning in the early 1980s, largely represents the great increase observed in the Columbia River estuary from 1984 to 2002. The initial colonization and growth of the Rice Island tern colony appears to have occurred because of the immigration of terns from large colonies in Washington (e.g., Grays Harbor and Willapa Bay). The continued growth and success of this colony at Rice Island, and now East Sand Island, are attributed to the stability of the human-created and/or maintained nesting habitat, reliable food supply of outmigrating juvenile salmonids (primarily hatchery smolts), and the apparent immigration of terns that have lost nesting habitat or were hazed from other colonies (e.g., Everett Naval Base, Washington). In 2003, the East Sand Island colony comprised 71 percent of the regional population (approximately 11,756 nesting pairs). Numbers of terns nesting on East Sand Island has been relatively stable since 1997 following the earlier period of exponential growth.

Breeding Caspian terns eat almost exclusively fish, catching a diverse array of species with shallow plunge dives, usually completely submerging themselves underwater. In the Columbia River estuary, diet studies of the Caspian tern colonies on Rice and East Sand islands documented that terns nesting on Rice Island (1999 to 2000) had an average of 83 (77 to 90) percent juvenile salmonids in their diet, while on East Sand Island (1999 to 2003), terns had an average of 36 (24 to 47) percent juvenile salmonids in their diet. From 1999 to 2003, the tern diet on East Sand Island, closer to the mouth of the Columbia River than Rice Island, was primarily non-salmonids, including northern anchovy, herring, shiner perch, sand lance, sculpins, smelt, and flatfish. As ocean conditions improved (e.g., increasing productivity of marine fish), and therefore, productivity, the percentage of juvenile salmonids in the diet of terns in the estuary has declined. In all other areas that have been studied, except Commencement Bay, salmonids were found to be uncommon diet items.

WASHINGTON. The distribution and abundance of Caspian terns in Washington has fluctuated dramatically since they were first reported in 1929. Breeding activity was first recorded in the 1950s with small coastal colonies in Grays Harbor. Coastal Washington once supported the largest colonies of breeding terns in the region (e.g., colonies in Grays Harbor). Currently, nesting Caspian terns are only documented to nest at Dungeness NWR, Potholes Reservoir, Banks Lake, and Crescent Island and all of these were small colonies consisting of less than 1,000 nesting pairs. A new colony at Dungeness NWR colony was established in 2003 and now constitutes the only current coastal nesting

site in Washington. A peak count of 300 adults was observed in 2003. Although the terns nested on less than 0.25 acre in 2003, more nesting habitat is available in the immediate area.

OREGON. Historically, breeding terns were restricted to shallow lakes and reservoirs of the Klamath Basin and Great Basin. In 1940, less than 1,000 pairs nested throughout Oregon. In recent years, tern numbers in Oregon averaged around 9,000 pairs. Currently, what has been considered the world's largest colony is found near the mouth of the Columbia River on East Sand Island, and small colonies still occur in interior Oregon. Nesting activity in the Columbia River estuary was first documented in 1984. Terns used habitat created by deposition of dredged material on the eastern tip of East Sand Island. By 1985, terns moved to nest on Rice Island. The number of terns peaked on Rice Island at 8,700 pairs in 1998. In 1999, a pilot study was implemented to attract the breeding colony of Caspian terns on Rice Island to East Sand Island. This effort included the removal of vegetation to create bare sand nesting habitat and social attraction techniques (i.e., decoys and audio playback systems) on East Sand Island. The project was successful and since 2001, all terns nesting in the estuary occur on East Sand Island. In 2002 and 2003, an average of 9143 breeding pairs nested on East Sand Island.

Caspian terns also nest in interior sites in Oregon (e.g., Summer, Crump, and Malheur lakes). The number of terns nesting at each site varies dependent on water levels and prey availability. Nesting activity in recent years have been absent because of drought conditions. In 2003, 49 pairs of terns nested at Crump Lake, while only 5 pairs nested at Summer Lake. Caspian terns are a casual visitor at Fern Ridge Lake during spring migration and in late summer during the post-breeding season dispersal and/or migration. Fern Ridge Lake does not contain a suitable nesting site for this species at present.

CALIFORNIA. The Statewide breeding population appears to have been relatively stable in the last 30 years. Throughout this period, numbers and location of breeding sites in California fluctuated and shifted, typical of a species reliant on ephemeral habitat for nesting. In San Francisco Bay, Caspian terns initially nested in salt ponds but later expanded or relocated to new sites, typically in response to disturbance from routine maintenance of salt pond levees or predation. Numbers of nesting terns in the bay have remained relatively stable during the past 20 years, but considerable annual movement among colony sites is common. During this period, annual breeding Caspian tern numbers ranged from approximately 1,000 to 2,600 pairs.

ESA-listed Salmonids

WASHINGTON. ESA-Listed Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, and bull trout occur in Dungeness Bay. Juvenile Chinook may be present in nearshore areas from May through mid-September and may reside up to 189 days in estuarine habitats. Overall, the abundance of Chinook salmon in the Puget Sound ESU has declined substantially, and both long and short-term abundance trends are predominantly downward. Increasing harvest, coupled with generally increasing trends in spawning escapement, provides evidence that chum salmon, while still ESA-listed, have been increasing in recent years within the Hood Canal ESU. Bull trout are native to the Pacific Northwest and western Canada. Bull trout within the Coastal/Puget Sound DPS were listed as threatened under the ESA in 1999. Bull trout generally spawn from August through November in small tributaries and headwater streams.

OREGON. Seven salmon and steelhead runs have population segments that are ESA-listed and spend a portion of their lives in the lower Columbia River. The species include 12 ESUs identified by NOAA Fisheries. See Table 3.3, Chapter 3 for a complete list of ESA-listed salmonids in the Columbia River. The first outbound migrants of the lower Columbia River fall Chinook and chum may arrive in the lower Columbia River as early as late February. The majority of these fish are present from March through June. Outbound Snake River fall Chinook begin their migration much farther upstream. They arrive in the lower Columbia River approximately a month later.

Bull trout are relatively dispersed throughout the tributaries of the Columbia River Basin, including its headwaters in Montana and Canada. The Columbia River DPS includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin and currently occur in 45 percent of the estimated historical range. A small number of bull trout has been reported from the area below Bonneville Dam.

CALIFORNIA. ESA-listed salmonid ESUs that occur in the San Francisco Bay estuary include the Sacramento River winter-run Chinook; Central Valley spring, fall, and late-fall run Chinook; Central Valley steelhead; Central California Coast steelhead; and Central California Coast coho. Most Sacramento River winter-run Chinook salmon juveniles rear in the Sacramento River through the fall and winter months. Some juveniles move downstream to rear in the lower Sacramento River and delta during the late fall and winter and may begin migrating downstream from December through March. Most yearling Central Valley spring-run Chinook

salmon move downstream in the first high flows of the winter from November through January, while some remain throughout the summer and exit the following fall as yearlings. Juvenile Central Valley steelhead live in freshwater from one to four years (usually two years in California), then smolt, and migrate to the sea from February through April. Central California Coast steelhead in most tributaries to San Francisco and San Pablo bays have been virtually extirpated. Fair to good runs of steelhead occur in coastal Marin County tributaries. Based on a 1994 to 1997 survey of 30 San Francisco Bay watersheds, NOAA Fisheries believes that there is a relatively broad distribution of steelhead in smaller streams throughout the watershed.

Environmental Consequences

Alternative A

Effects to Caspian Terns

WASHINGTON. Under this No Action alternative, available nesting sites and the number of Caspian terns nesting in Washington are not expected to substantially change. The number of nesting terns could increase at Dungeness NWR or eastern Washington if habitat is maximized (see below) on East Sand Island (projected in 2009). However, we do not expect the colony sizes at these sites to increase substantially in numbers because these sites are limited by size of available nesting area, disturbances to the colony, or prey availability.

OREGON. Based on a simple deterministic model developed by D. Roby (USGS), we project the tern colony on East Sand Island would increase to approximately 18,000 breeding pairs by 2009. This projected increase is attributed to the recruitment of a high number of juvenile terns that were produced between 2001 and 2003. This projected breeding concentration would leave a large percentage of the regional tern population more vulnerable to stochastic events (e.g., storms, human disturbance, predation, and disease) as compared to smaller, more traditionally sized tern colonies dispersed throughout the region.

If the colony increases as projected in 2009, terns would need to look for habitat elsewhere and would likely seek new nesting sites in the estuary (e.g., Rice Island, Miller Sands Spit, or Pillar Rock Island). Aggressive hazing early in the nesting season would be implemented to prevent terns from nesting on these islands. If the hazing is unsuccessful in preventing nesting, egg removal would be initiated immediately. Since egg removal would be conducted with the earliest nesting attempts, we expect a small number of eggs would be collected, thus, effects to the breeding birds

would be minimal. In addition, since egg removal would be conducted early in the breeding season, nesting terns would have the opportunity to renest at other sites.

We expect existing conditions at Summer and Crump lakes to continue (nesting tern numbers would change every year depending on fluctuating water levels, exposure of nesting islands, and available prey). Nesting habitat does not currently exist at Fern Ridge Lake, thus, we do not expect terns to nest in this area under this alternative.

CALIFORNIA. As in Washington, available nesting sites and the number of Caspian terns nesting in California is not expected to change substantially under this alternative. The stable population trend that has been observed in the last 30 years would most likely continue, with shifts in the number and location of breeding sites, characteristic of tern breeding ecology.

REGION. Regional Population: Under this alternative, the overall Caspian tern Pacific Coast regional population is expected to maintain its' current trend until nesting habitat is fully occupied on East Sand Island. We expect the regional population trend to stabilize once the East Sand Island colony growth stabilizes. Specific colony locations and sizes throughout the region are anticipated to change from year to year, typical for this species. Although in recent years (1997 to present) the East Sand Island colony size has remained relatively stable, we anticipate a growth in the next decade attributed to recruitment of a high number of juvenile terns that fledged between 2001 and 2003.

Regional habitat. Current nesting sites throughout the region would most likely continue to provide a suite of locations for terns on a regional scale. However, we expect East Sand Island would continue to support the majority of breeding terns in the region because of the stable nesting habitat and abundant prey resources. Many of the other sites in the region vary in suitability every year (e.g., fluctuating water levels, prey resources, and predators).

Effects to ESA-listed Salmonids

WASHINGTON. Current effects at Dungeness NWR of this No Action alternative, to Puget Sound Chinook and Hood Canal summer-run chum salmon, steelhead, and bull trout have not been quantified. Based on diet studies of terns nesting in similar habitats (i.e., highly marine coastal sites) and the small colony size (less than 200 breeding pairs), we expect juvenile salmonids to comprise a small percent of their diet. Thus, we expect effects to ESA-listed salmonids at Dungeness NWR to not be substantial. The number of nesting terns could increase

in Washington if habitat is maximized on East Sand Island (projected in 2009). However, we do not expect the colony sizes at existing sites (Dungeness NWR and eastern Washington) to increase substantially in numbers because these sites are limited by size of available nesting area, disturbances to the colony, or prey availability. Effects to six ESA-listed stocks that originate in part in Washington would continue to be affected by tern consumption in the Columbia River estuary.

OREGON. Continued effects to ESA-listed salmonids, traveling through and/or rearing in the Columbia River estuary are expected under this alternative. There would be a continued and projected increase in predation of ESA-listed juvenile salmonids by Caspian terns as the colony continues to increase in size. The number of juvenile salmonids annually consumed by terns is expected to increase as the tern colony size increases. The benefits gained from the relocation of terns from Rice Island to East Sand Island would be substantially lost as the tern colony continues to grow. More importantly, Alternative A would not result in any appreciable improvement in population growth rate for ESA-listed steelhead. The larger tern colony size and/or predation levels could suppress the population growth rate for ESA-listed salmonids. Since salmonids do not occur in Summer and Crump lakes, no effects are expected.

CALIFORNIA. In San Francisco Bay, outmigration periods for ESA-listed salmonids overlaps with the tern breeding season. Despite this overlap in salmonid outmigration and the tern nesting season, a study in 2003 demonstrated that juvenile salmonids comprise a small portion of the diet of terns in San Francisco Bay. Thus, we expect the effects to ESA-listed salmonids to be limited.

Alternative B

Effects to Caspian Terns

WASHINGTON. Under this alternative, the potential for new colonies to become established or the growth of existing colonies in Washington is expected to be high after tern nesting habitat is lost on East Sand Island. At that time, terns would need to seek nesting habitat outside the Columbia River estuary. Thus, existing colonies on Dungeness NWR and in eastern Washington could grow in size. However, as described in Alternative A, we do not expect tern colonies at Dungeness NWR and eastern Washington to increase substantially in numbers because these sites are limited by size of available nesting area, disturbances to the colony, or prey availability. This would limit potential increases in consumption of ESA-listed juvenile salmonids. If nesting tern numbers increase substantially at the eastern Washington sites, where terns are known to forage on ESA-listed salmonids in the mid-Columbia River, Federal, Tribal, and State partners

would initiate discussions to ensure that impacts to Columbia River salmonids are minimized.

OREGON. With no management of nesting habitat on East Sand Island, the tern nesting area would become vegetated within 3 years, making the site unusable by nesting terns. Terns would need to look for nesting habitat elsewhere in the region or estuary. This would increase the possibility that terns would return to nest on Rice Island or other islands in the estuary, however, active measures would be implemented to prevent terns from nesting on these islands. Effects would be similar to that described in Alternative A, except that the potential take of eggs could be higher since the entire East Sand Island tern colony would be displaced and probably attempt to nest on upper estuary islands. Similar to Alternative A, we expect existing conditions at Summer and Crump lakes to continue (nesting tern numbers would change every year depending on fluctuating water levels, exposure of nesting islands, and available prey). Thus, although displaced terns from East Sand Island would be actively searching for new nesting sites, we do not expect the number of nesting terns at Crump and Summer lakes to increase substantially because of these limiting conditions. No nesting habitat is currently available at Fern Ridge Lake, thus tern nesting is not expected at this location.

CALIFORNIA. As in Washington, existing tern colonies in California may see an influx of displaced terns from the Columbia River estuary, resulting in growth of colony sizes or establishment of new colonies. However, displaced terns would need to select from existing nesting sites currently available, as this alternative does not propose any habitat management actions. Sites within San Francisco Bay appear to have available nesting habitat that is most similar to that found in the Columbia River estuary. However, as described in Alternative A, increases in the number of nesting terns at individual colonies are expected to be within the range observed in the past (e.g., 22 to 2,100 nesting pairs).

REGION. Regional Population. The overall Pacific Coast regional population is expected to stop its increasing trend once the highly successful colony on East Sand Island is lost. We expect an initial decrease in reproductive success because displaced terns from East Sand Island may not be able to breed for a year or two before they find new nesting sites or breed successfully. However, we expect most of the displaced terns to eventually find alternative nesting sites elsewhere within the Pacific Coast region, and potentially in other regions within their continental distribution. Although terns displaced from East Sand Island may find nesting sites elsewhere in the region, those sites may not be as productive as observed in the Columbia River estuary. Thus, even though displaced terns are able

to find alternative nesting sites, this expected lower productivity could still result in an overall decrease in productivity of terns in the region. Ultimately, we expect the regional population trend would stabilize, but possibly at a lower number than currently observed, but remain above those documented in the late 1970s and early 1980s (approximately 6,200 breeding pairs).

Regional habitat. Similar to Alternative A, current nesting sites throughout the region would most likely continue to provide a suite of locations for terns on a regional scale. The majority of the sites that do not require habitat enhancement and are currently available to terns are located in California. Other sites in Washington or Oregon require management and/or enhancement and would most likely not be used by displaced terns.

Effects to ESA-listed Salmonids

WASHINGTON. If Dungeness NWR is colonized by higher numbers of Caspian terns as a result of the loss of habitat in the Columbia River estuary, it is probable that an increase in consumption of ESA-listed salmonids (Puget Sound Chinook and Hood Canal summer-run chum) could occur. However because this colony would likely remain small (range somewhere between 100 to 1,000 nesting pairs) and alternative prey are abundant, effects are expected to remain limited. Displaced terns from the Columbia River estuary could potentially nest at existing sites in eastern Washington, provided site conditions are suitable. However, we do not expect these colonies to increase substantially in numbers because most of these sites are limited by size of available nesting area, disturbances to the colony, or prey availability. These characteristics, thus, would limit potential increases in consumption of juvenile salmonids.

OREGON. The loss of tern nesting habitat on East Sand Island in conjunction with implementation measures common to all alternatives (prevention of tern nesting at upper estuary islands), Caspian terns would be eliminated from the estuary. This would result in a substantial reduction and eventual elimination of tern predation on ESA-listed salmonids in the estuary. Implementation of this alternative would result in a positive change in steelhead population growth rates that would be realized within 6 to 7 years after implementation of this alternative.

CALIFORNIA. In San Francisco Bay, a probable increase of predation on ESA-listed salmonids would occur if terns displaced from the Columbia River estuary select to nest in the bay. However, as described in Alternative A, effects to ESA-listed salmonids are expected to be limited as tern numbers are not expected to grow substantially and

salmonids were not observed to be primary prey for terns in San Francisco Bay in 2003.

Alternative C – PREFERRED ALTERNATIVE

Effects to Caspian Terns

WASHINGTON. Similar to Alternative B, the colony on Dungeness NWR could increase in size from the immigration of displaced terns from East Sand Island under this alternative. Management actions may be taken to protect this colony from possible disturbance from humans and/or predators. If management efforts are implemented, we expect the size of this colony could grow to range somewhere within the historic colony sizes observed in the Washington coast (100 to 3,500 breeding pairs). Similar to Alternatives A and B, there is also a potential for establishment of new colonies or enlargement of existing sites in eastern Washington. The likelihood of this occurring however, would be lower than in Alternatives A and B because proposed management at alternate sites in the region is expected to attract the majority of displaced terns. Additionally, as described in Alternatives A and B, most of these sites are limited by size of available nesting area, disturbances to the colony, fluctuating water levels, or prey availability. Thus, even if some displaced terns nest at these sites, we do not expect the size of these colonies to increase substantially, limiting potential increases in consumption of Columbia River juvenile salmonids. As with Alternatives A and B, if nesting tern numbers increase substantially in these upper Columbia River sites, Federal, Tribal, and State partners, including appropriate land owners and managers, would initiate discussions as part of the adaptive management approach proposed in this DEIS, to ensure that impacts to Columbia River salmonids are minimized.

OREGON. Based on the range of known nesting densities in the estuary, we expect that the tern colony on East Sand Island would decrease to approximately 2,500 to 3,125 breeding pairs when nesting habitat is restricted to approximately one to 1.5 acres. This would be a 60 to 70 percent decrease from the 2003 colony size, a substantial decrease in this colony. We expect that terns displaced from East Sand Island to find nesting sites elsewhere in the region, especially since this alternative proposes to manage approximately 8 acres of habitat specifically for Caspian terns. However, other tern nesting sites in the region have not been observed to be as productive as in the Columbia River estuary (except for Solstice Island, Washington). Thus, displaced terns may incur an overall decrease in productivity to levels more similar to those typically observed in the region. The active measures (e.g., hazing, egg take, etc.) that would be implemented to prevent terns from nesting on the upper estuary islands

would result in effects similar to that described in Alternative A.

Some of these displaced terns could be attracted to nest at Summer, Crump, and/or Fern Ridge lakes as management actions are proposed for these sites in this Alternative. At Summer Lake, we expect that nesting tern numbers could range between 5 to 300 breeding pairs. At Crump Lake, the newly created 1-acre island could also support numbers of terns similar to that expected at Summer Lake. Prey base may be limiting at these two sites, and thus, the actual number of terns that can successfully nest at Summer and Crump lakes may not be as high as the nesting habitat could accommodate. At Fern Ridge Lake, we expect the number of nesting terns at this site to be similar to that of Summer and Crump lakes (5 to 300 breeding pairs). However, since this is not a historic nesting site, social attraction efforts may need to extend over a number of years before terns initiate nesting at this site.

CALIFORNIA. The number of terns nesting in California would most likely increase substantially from the immigration of terns displaced from the Columbia River estuary. In San Francisco Bay, the current colony on Brooks Island could grow from an average of approximately 900 pairs to at least 1,500 breeding pairs after habitat is enhanced, but could grow larger if conditions (e.g. prey abundance or predators) are suitable. At the two remaining sites in San Francisco Bay (Hayward Regional Shoreline and Ponds N1-N9), colony sizes are expected to range between 100 to 1,500 breeding pairs (at each site), depending on the success in attracting terns to these new nesting sites.

REGION. Regional population. We expect a substantial effect to the distribution and initial reproductive success of the Caspian tern regional population under this alternative. An estimated 6,000 to 6,600 breeding pairs of Caspian terns would be displaced from East Sand Island as tern nesting habitat is reduced. The dispersal of this large concentrated colony would be a benefit to the regional population because the potential risk of this large segment of the population to catastrophic events (e.g., disease, predators, storms,) would be removed. Additionally, increasing the network of nesting sites in both coastal and interior locations with varying conditions offers a better potential for maintaining a stable regional population over time in comparison to a network comprised of fewer sites and with larger concentrations of nesting terns. Although we attempt to project the response of displaced birds, Caspian terns may pioneer into locations not discussed in this DEIS on their own volition. Thus, since this species takes advantage of ephemeral habitat and forage conditions over a wide geographical range, we cannot predict with complete

certainty where colonies would establish themselves in the future.

We expect that the managed sites would provide suitable habitat to accommodate displaced terns, particularly when combined with existing sites. However, we still would expect an initial decrease in reproductive success because displaced terns from East Sand Island may not breed for a year or two before they find new nesting sites or breed successfully. In the long-term, we expect the regional population to stabilize, possibly at a lower number than currently observed, but remain well above those documented in late 1970s and early 1980s (approximately 6,200 nesting pairs). If the regional population declines to fifty percent of the current size (the number observed in the late 1970s and early 1980s), management of Caspian tern nesting sites in the region would be reevaluated as part of the adaptive management approach proposed in this DEIS.

Regional habitat. Similar to Alternatives A and B, current nesting sites throughout the region would most likely continue to provide a suite of locations suitable for supporting terns on a regional scale. However, unlike Alternatives A and B, the development of approximately 8 acres of nesting habitat proposed under this alternative would ensure that an enhanced network of nesting sites, dispersed throughout the Pacific Coast region, would be available for terns displaced from East Sand Island. Displaced terns would be able to select from these managed sites as well as underutilized existing habitat throughout the region. Even though habitat would be developed for nesting Caspian terns, terns are expected to nest opportunistically throughout the region based on various factors (e.g., food resources, proper nesting substrate, competition, or predation). Thus, specific colony locations and sizes throughout the region would change from year to year as is currently observed. This alternative provides a more enhanced suite of locations suitable for supporting terns on a regional scale (as compared to Alternatives A and B).

Effects to ESA-listed Salmonids

WASHINGTON. Effects to Puget Sound Chinook and Hood Canal summer-run chum would be similar to that described in Alternative B with the exception that management actions that may be implemented to further protect the nesting site on Dungeness NWR for terns could result in an increased number of terns. As described in Alternative B, the potential increase in Caspian terns would probably result in an increase in consumption of ESA-listed juvenile salmonids. Effects, however, are expected to remain limited. Similar to Alternative B, there is a potential for displaced terns from the Columbia River estuary to nest in eastern Washington. The likelihood of

this occurring, however, would be lower than in Alternatives A and B because proposed management at alternate sites in Oregon and California is expected to attract majority of displaced terns.

OREGON. Based on the NOAA Fisheries analysis, population growth rate for Columbia River steelhead ESUs increases would occur within one generation (4 to 5 years). We expect the reduction in size of the tern colony on East Sand Island to 2,500 to 3,125 breeding pairs is expected to occur within 3 to 5 years after implementation of this alternative. Thus, initial benefits for ESA-listed salmonids could be realized within 6 to 7 years after program implementation. The projected improvement in steelhead population growth rate is similar in magnitude to that of increases in steelhead population growth rates that would result from hydropower improvements (0 to 4 percent increase), but well below improvements that could be achieved by harvest reductions (4 to 8 percent increase). Ultimately, long-term benefits to ESA-listed salmonids in the Columbia River estuary would depend on the ability to maintain available nesting habitat to a level that continues to maintain a range of nesting terns of 2,500 to 3,125 pairs identified in this DEIS. However, long-term success of efforts intended to increase population growth rates of ESA-listed salmonids must be placed in context with other sources of mortality subject to human intervention. Cumulatively, the variety of salmon recovery actions have the potential to influence population growth rate to a substantially greater degree than would be realized from solely reducing predation from avian predators in the Columbia River estuary.

At Fern Ridge Lake, Caspian terns could forage many miles away from the nesting site. A 15 mile radius around Fern Ridge Lake includes portions of the Willamette and McKenzie rivers. If Caspian terns successfully nested at Fern Ridge Lake, terns would occur in the general area during the mid- to latter stages of the outmigration period for ESA-listed salmonids. Thus, terns could potentially consume juvenile salmonids if they forage in the Willamette and McKenzie rivers. However, effects to these ESA-listed salmonids are expected to be limited because the number of nesting terns are expected to be small (5 to 300 pairs).

CALIFORNIA. Effects to ESA-listed salmonids have the potential to increase under this alternative because specific sites in San Francisco Bay may be managed to attract displaced terns from the Columbia River estuary. However, as described in Alternatives A and B, although there is some overlap with the outmigration periods of these salmonid species during the tern breeding season, effects are expected to remain limited. In particular, the diet study conducted in 2003 indicated that

salmonids comprise a small portion of the tern diet and individual colony sizes (100 to 1,500 pairs) are predicted to remain small in comparison to that observed in the Columbia River estuary. Additionally, alternative prey (e.g. marine fishes) are most likely abundant and available to nesting terns, reducing the potential for terns to prey on salmonids.

Alternative D

Effects to Caspian Terns

WASHINGTON. Effects of habitat management actions proposed in this alternative in Washington would be similar to that described in Alternative C. Since specific habitat would be managed at alternate sites for terns, the likelihood that displaced terns would increase in numbers or establish new colonies in Washington is lower than that expected in Alternative B. However, if a lethal control program is implemented and causes the entire colony on East Sand Island to abandon the site, the pressure of finding alternative nesting habitat would be greater than anticipated in Alternative C. On the other hand, if lethal control is implemented and is successful in reducing the number of breeding terns on East Sand Island by fifty percent, then the actual number of displaced terns would be less than Alternative C and few terns would be expected to breed in Washington.

OREGON. Effects to Caspian tern numbers in Oregon would be the same as that described in Alternative C, except if a lethal control program is implemented. The decreased number of breeding terns in the Columbia River estuary would be a result of both the redistribution of terns due to habitat loss on East Sand Island and the direct loss of breeding birds through a lethal control program. The lethal control program would kill approximately 50 percent of the breeding birds (2,500 to 3,000 annually) for several years until the proposed range of nesting pairs is attained. Although the intention would be to kill a specific number of terns every year to maintain a colony within the target range, the control methods and associated activities (e.g., rocket nets, human activity in the colony) themselves may be disturbing to the entire colony. This may result in complete abandonment of the site and dispersal of these birds back to upper estuary islands or other locations in the region. Thus, effects to the tern colony on East Sand Island under this alternative are expected to be substantial. Similar to Alternative C, we expect small colonies (5 to 300 breeding pairs) at Summer, Crump, and Fern Ridge lakes as a result of habitat enhancement activities at these sites.

CALIFORNIA. Since management actions at specific sites in California are the same as proposed in Alternative C, effects to Caspian tern colonies in California would be similar to that described in

Alternative C. However, if a lethal control program is implemented and causes the entire colony on East Sand Island to abandon the site, the pressure of finding alternative nesting habitat would be greater than anticipated in Alternative C. On the other hand, if lethal control is implemented and is successful in reducing the number of breeding terns on East Sand Island, then the actual number of displaced terns would be less than Alternative C and fewer terns would be expected to breed in California.

Region. Regional population. If habitat reduction is successful in redistributing displaced terns from East Sand Island to elsewhere in the region, effects to the regional tern population would be similar to that described in Alternative C, resulting in a regional population that could initially decline but eventually stabilize at levels higher than documented in the late 1970s and early 1980s. However, if a lethal control program is implemented, this alternative, unlike all remaining alternatives, would result in a population control program for Caspian terns. If the proposed number of terns is removed from the population, we would expect to see a reduction of the regional tern population by approximately fifty percent. This is a substantial decrease to the regional tern population.

Regional habitat. Similar to Alternative C, the development of approximately 8 acres of nesting habitat, in addition to current nesting sites would provide an enhanced suite of locations suitable for supporting terns on a regional scale (as compared to Alternatives A and B). Displaced terns would be able to select from sites managed specifically for nesting terns as well as underutilized existing habitat throughout the region. Specific colony locations and sizes throughout the region are expected to change from year to year as is currently observed.

Effects to ESA-listed Salmonids

Effects to ESA-listed salmonids in Washington, Oregon, and California are similar to that described in Alternative C, with the exception that if lethal control is implemented to reduce the colony size on East Sand Island, the overall number of birds that may be displaced from the Columbia River estuary may be lower than expected in Alternative C. Thus, fewer salmon would be lost due to tern predation in Washington, Oregon, and California.

Cumulative Effects

This section addresses the potential cumulative effects for all of the alternatives and is intended to consider the proposed action in the context of other actions on a larger temporal and spatial scale. The large breeding concentration of terns in the Columbia River estuary is more vulnerable to stochastic events (e.g., storms, predators) and

disease as compared to a similar population that is dispersed among many smaller colonies. Thus, dispersal of the large and concentrated tern colony on East Sand Island would result in a benefit to the regional population because the potential risk of this large segment (approximately 70 percent) of the population to catastrophic events would be removed. Additionally, increasing the network of nesting sites in both coastal and interior locations with varying conditions offers a better potential for maintaining a stable regional population over time in comparison to a network comprised of fewer sites and concentrations of larger individual colonies. The proposed enhanced suite of nesting locations would provide more suitable habitat for supporting terns on a regional scale as well as help support other management actions to decrease the loss of juvenile salmonids in the Columbia River estuary.

Reducing tern predation in the estuary is one additional mechanism that can be used to improve juvenile salmonid survival, thereby increasing population growth rates of ESA-listed salmonids in the Columbia River Basin. Many of the measures taken to restore salmonids in the Columbia River Basin have focused on improving survival of juvenile salmonids through the mainstem dams. The reduction in tern predation on juvenile salmonids would complement and protect benefits associated with upstream efforts to increase the number of juvenile salmonids reaching the ocean.

Ultimately, long-term benefits to ESA-listed salmonids in the Columbia River estuary would depend on maintaining nesting habitat on East Sand Island to support the proposed range of terns (2,500 to 3,125 pairs). However, long-term success of efforts intended to increase population growth rates of ESA-listed salmonids must be placed in context with other sources of mortality subject to human intervention. Hydropower operations, harvest impacts, habitat conditions, hatchery operations, and introduced species all have the potential to affect population growth rates of ESA-listed salmonids, and are subject in various degrees to management efforts to alleviate detrimental effects. Actions to address these impacts have been implemented or proposed, and others may be developed in the future. Cumulatively, these actions have the potential to influence population growth rate to a substantially greater degree than would be realized from solely reducing predation from avian predators in the Columbia River estuary.